**NRU HSE-2019, Microeconomics Class-12**

# Externalities

**1.** Consider a society with 2 agents. Agent 1 takes an action  where . Action  generates utility of  for agent 1. This action also affects agent 2. The utility of agent 2 if 1 takes action  is given by .

**(a)** Let  denote the individually optimal level of  for agent 1 and  denote the socially optimal level of . Calculate  and . Produce graphical solution. Compare  and  and explain the result.

**(b)** Suppose the government imposes a proportional tax of  on  on agent 1. Calculate the value of  for which  is equal to .

**(c)** Suppose the government allocates the property right on the action to agent 1, so that 1 can now ask 2 for a payment in order to reduce a. Show that 1 would optimally adopt  in this case.

**(d)** Would the adopted level of  be different if the property right is allocated to agent 2? Explain.

**2.** Consider two farmers that produce tomatoes $t$ and a nearby factory producing good $y$. The cost functions are: $c\_{1}\left(t\_{1},x\_{1}\right)=\left(t\_{1}\right)^{2}+\left(2-x\_{1}\right)^{2}$ and $c\_{2}\left(t\_{2},x\_{2}\right)=\left(t\_{2}\right)^{2}+\left(2-x\_{2}\right)^{2}$ for farmer 1 and 2 correspondingly, where $t\_{i}$ is the amount of tomatoes produced by farmer $i$ and $x\_{i}$ is the amount of fertilizers used in the production process by farmer $i$. Fertilizers pollute water that is used by the nearby factory making the production of good $y$ more expensive. The cost of production of good $y$ is $0.5\left(y\right)^{2}+0.5\left(x\_{1}+x\_{2}\right)^{2}$. Both goods are sold at perfectly competitive markets at prices $p\_{t}=4$ and $p\_{y}=12$.

**(a)** Find the equilibrium level of production of each good and the fertilizers used by each firm.

**(b)** Explain, why the outcome of part (a) is not socially efficient and provide graphical solution. Derive the value of society loss.

**(c)** Suppose that factory that produces good $y$ has a legal right for clean water. Factory is ready to sell its right fully or partially to the farmers at a per unit price $p\_{x}$. Assuming that all the agents are price-takers at this new market, find the equilibrium value of $p\_{x}$. Is the resulting allocation efficient?